

Space News Roundup

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National Aeronautics and Space Administration



JSC Photo

Student experimenter Lloyd Bruce, left, explains the workings of his Titanium Grain Formation Experiment to Mission Specialists Pinky Nelson and Mike Lounge.

Idea goes from comics to cosmos

Developers of two student experiments scheduled to fly aboard STS-26 visited JSC earlier this week to show Mission Specialists Mike Lounge and Pinky Nelson how to handle the secondary payloads while in orbit.

The experiments will examine how metal grains form and crystals grow in microgravity, and the developers hope they will help make airplanes more fuel efficient and X-ray films more sensitive.

Lloyd Bruce of St. Louis, who developed the Titanium Grain Formation Experiment, said his project is designed to observe the effect that microgravity has on phase transformation and resolidification in a titanium alloy.

"Basically, what it involves is heating up a titanium alloy in a microgravity environment and observing what happens to the molecular and crystal grain formations," said Bruce, who began working on the experiment while at Sumner High School in St. Louis. He has continued the project at the University of Missouri, Columbia.

"I did a little research on the old Skylab missions and referred to my comic book collection, and between the two and a little bit of Star Trek I came up with the experiment," he said.

"An example of an application would be lighter airplane engine parts or airplane parts in general that would in turn make the airplane more fuel efficient," he said.

Charles Schaife, a professor at Union College of Schenectady, N.Y., explained the Crystal Membrane Experiment developed by Richard Cavoli of Marlboro, N.Y. Cavoli was unable to attend the briefing, and Schaife has been guiding the experiment since Cavoli went on to medical school. The experiment was to be performed on STS 51-L.

The experiment uses a cylinder with four compartments, he said. The inner two are filled with deionized water and have a plastic membrane between them. One outer compartment contains lead acetate, a source of lead ions, and the other contains potassium

(Continued on page 2)

August time frame

Return to flight slips because of boot ring switch

Refitting the solid rocket motors being prepared for STS-26 with the successfully tested Development Motor-8 outer boot ring configuration will delay the launch until mid-July or August, according to Rear Adm. Richard Truly.

"We're well on our way to a good solution to the problem, understanding what happened, and also to justifying to ourselves that we have a design that's safe," said Truly. NASA's associate administrator for space flight. "I believe that we are six to 10 weeks from our previous planning date for first flight. That puts the next Shuttle flight in the August time frame."

The earliest possible launch date for STS-26 would be July 15 if the DM-8 boot ring

configuration were used and there were no schedule delays, Truly said at a Jan. 11 press conference following a meeting of the Management Council of the Office of Space Flight at Huntsville, Ala. The council is made up of Truly, the directors of JSC, Kennedy Space Center, Marshall Space Flight Center and the National Space Technology Laboratories. He said the failure analysis team's investigation is expected to be complete in two or three weeks.

An exact target date will be formulated after the Development Motor-9 (DM-9) outer boot ring break-up investigation is complete, and the

results have been reviewed at a special Program Directors Management Review (PDMR) chaired by Space Shuttle Program Director Arnold Aldrich and another council meeting, he said.

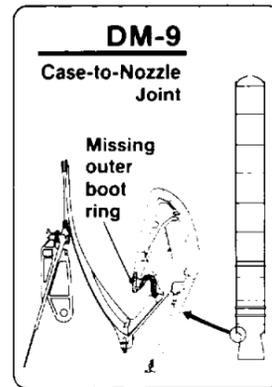
Truly said the analysis team has determined that the DM-9 boot ring failure occurred one to two seconds following the Dec. 23 full-duration firing during a post-firing gimbal.

MSFC Director J. R. Thompson said the failure analysis team, made up of engineers at Marshall and Morton Thiokol Inc., found severe delamination in the DM-9 outer boot ring, and he suspects the flaw occurred because of the way an internal ply of carbon cloth was laid on before curing.

Delamination is the unraveling of the carbon plies that make up the carbon phenolic block that is the outer boot ring, Thompson explained. The ablative ring protects the flex bearing from 4,000-plus degrees Fahrenheit generated by the SRM. The flex bearing is the reusable part of the solid rocket motor (SRM) that allows the nozzle to be swiveled and thus "steer" the Space Shuttle.

Although the analysis team is still evaluating data from DM-9, Thompson said it appears the failure was caused by the severe thermal environment, not the mechanical loads

(Continued on page 2)



Paychecks will reflect 2 percent wage hike

Most civil service employees at JSC will receive about 2 percent more in their paychecks dated Jan. 26 as a result of budget legislation approved in December.

The raise became effective during the pay period beginning Jan. 3, said Curtis Collins, JSC classification and wage officer. Individual employees may receive slightly more or less than the 2 percent because of the Office of Personal Management formula used to determine the

new pay schedule, he said.

Executive Order No. 12622 authorized the general schedule salary increase, Collins said. The raise does not apply to some employees under special salary rate schedules. Collins said the Human Resources Office is awaiting word on whether a separate executive order will approve similar increases for those employees.

The same budget legislation also affected provisions for lump-sum

retirement benefits and expanded an experimental program that will allow employees to donate accrued annual leave to deserving employees in an emergency.

Under the retirement change, employees retiring after Jan. 2, 1988, and electing to use the lump-sum option, will receive 60 percent of contributions upon retirement and the remaining 40 percent, plus interest, one year later, said Dianna Mancuso of Human Resources'

Staffing, Examining and Administrative Support Section. This option expires Sept. 30, 1989, and it is unclear what option will then be available.

The leave sharing plan is not yet in effect, but will make available to all federal employees a modified version of a program tested in three cases during 1987, said Bob Hall, chief of Human Resources' Programs and Policy Office. The program is designed to allow employees to

help colleagues who have used up all available leave due to emergencies such as extended or catastrophic illnesses.

OPM is expected to publish implementation regulations for the program by late February, Hall said. Once those regulations are published, the program will be in effect until Sept. 30, 1988. Hall said the experimental program may be extended or made permanent.

Miniprobes

Rail guns could propel small payloads into space

Miniature spacecraft—the size of a coffee can—could be launched by electromagnetic rail guns to conduct dozens of different space exploration missions, according to an engineer at the Jet Propulsion Laboratory.

Ross Jones of JPL's spacecraft systems engineering section said Earth-orbiting electromagnetic launchers, or rail guns, being developed for the U.S. Strategic Defense Initiative Office, could be useful in launching very small, low-cost scientific probes to various destinations in the solar system. He discussed the proposal in a paper presented at the American Institute of Aeronautics and Astronautics' Aerospace Sciences Conference in Reno, Nev., on Jan. 11.

Electromagnetic launchers are

being developed by the U.S. military for use both on the ground and in space. Instead of using explosive power to propel a projectile, electromagnetic guns and launchers generate brief but powerful electrical pulses that produce strong electromagnetic forces that accelerate projectiles to extremely high velocities.

By taking advantage of the small-scale construction possible with microelectronics, and by limiting the science objectives of a mission, spacecraft weighing about three pounds could be launched by Earth-orbiting rail guns on trajectories toward the sun, planets, asteroids, comets or interplanetary space. For example, a spacecraft could study one aspect of a planet's atmosphere or one aspect of a comet's or

asteroid's chemical composition.

"Instead of one large, expensive spacecraft launched every few years," said Jones, NASA "could launch perhaps 10 to 50 identical, small, relatively inexpensive spacecraft per year." He estimates that such spacecraft could be developed at a fraction of the cost of today's sophisticated, multi-instrument spacecraft, which cost from \$300 to \$800 million.

"Small spacecraft would call for an entirely different approach to space science compared to current practice, but not so different from what was practiced at the beginning of the space age 30 years ago when probes weighing less than 50 pounds were the norm," Jones added.



JSC Photo by Sheri Dunnette

Construction of the new Central Computing Facility between Bldgs. 45 and 47 is progressing, despite bouts with wet weather and subterranean quick sand. JSC's Project Manager Tom Conger said Cahaba Construction Co. has completed about 12 percent of the work. Completion is expected in November or December.

People

JSC scientist cited in Soviet Journal

Thomas L. Wilson of the Mission Support Directorate has been cited in the current issue of the Soviet Journal of Nuclear Physics for his work on neutrino tomography here at JSC. Wilson's 1984 paper in Nature magazine introduced the idea of CAT-scanning the Earth using neutrino. He first presented his idea at a summer workshop on positron imaging at the Massachusetts Institute of Technology in 1978. Wilson came to JSC in 1976 as a theoretical physicist from Rice University and is currently working on gamma-ray burst mechanisms at the galactic center in support of NASA's Gamma Ray Observatory (GRO) and Advanced X-Ray Astrophysics Facility (AXAF).



Wilson

Bellonby honored for excellence

Joan Bellonby, Logistics Division secretary, has received the Marilyn J. Bocking Secretarial Excellence Award. Bellonby has shown superior technical knowledge in the use of automated office equipment and eagerness to learn new techniques. She prepares all correspondence for the division staff including the division chief, the JSC supply and equipment management officer, and a program analyst. Bellonby conducts regular meetings for the division's clerical personnel to discuss changes, corrections and topics of common interests. Other implementations include a new filing system, and an index of those files.



Bellonby

Garriott takes Teledyne Brown post

Dr. Owen K. Garriott, a former NASA scientist-astronaut, has been named vice president of space programs at Teledyne Brown Engineering, Huntsville, Ala. Garriott replaces Robert A. K. Mitchell, who will become president of Teledyne Ryan Aeronautical in San Diego. Garriott was one of the first six scientist-astronauts selected by NASA in 1965 and spent 21 years with the space agency. He spent 59 days in orbit on Skylab-3 and was a member of the STS-9 crew. Prior to joining NASA, he was an associate professor of electrical engineering at Stanford University.



Garriott

Bulletin Board

Credit Union directors election on March 3

Three members of the JSC Federal Credit Union board of directors will be elected for three-year terms on March 3. Directors are volunteers who serve without pay and determine policies that guide the day-to-day operation of the credit union. Any member who wishes to run for one of the three positions should submit a resume detailing experience and qualifications to James H. Ragan, Nominating Committee Chairman, JSC Federal Credit Union, PO Box 58346, 77258. The deadline is Feb. 2. For more information, call Ragan at x33646.

Asian Pacific American Heritage Day is Jan. 22

JSC will observe its first Asian Pacific American Heritage Day on Jan. 22. This event is in remembrance of Col. Ellison Onizuka, first Asian American astronaut. Mrs. Lorna Onizuka and Dr. Shien Biau Woo, Lt. Governor of Delaware, will be the keynote speakers and have selected "The Role of Asian Americans in the Making of the American Dream" as the topic. The program includes morning workshops at the Gilruth Recreation Center and afternoon performances depicting various cultures in the Bldg. 2 auditorium. Cultural displays will be in the lobby of the Visitor Center and additional artifact displays will be in the Bldg. 45 Technical Library the week of Jan. 19. Other displays will be in the Bldg. 1 lobby. For more information, call Eleanor Der Bing at x33200.

JSC night at the Summit scheduled Feb. 27

The last JSC-EAA night at the Summit will be Saturday, Feb. 27. The Houston Rockets will take on the San Antonio Spurs. Tickets will be sold for \$7 each at the Bldg. 3 cafeteria from 10 a.m. to 2 p.m. on Feb. 23. Purchase is limited to eight tickets per person and a NASA-issued badge is required.

Bay Area PC Organization to meet Jan. 26

The next meeting of the Bay Area PC Organization (BAPCO), the local IBM PC user's group, will be at 7:30 p.m. Jan. 26, at League City Bank & Trust, 303 E. Main, League City. The featured speaker will be a representative from Microsoft. The group is open to people interested in microcomputers and meets regularly on the third Tuesday of each month. For more information call Earl Rubenstein, x34807 or Jack Calvin, 326-2983.

Spaceweek volunteers to meet Jan. 23

Spaceweek National Headquarters will hold a volunteer kickoff meeting at the Gilruth Center on Jan. 23. There will be a morning session at 10 a.m. and an afternoon session at 1 p.m. Anyone interested in working on Spaceweek '88 is invited to attend one of the sessions. For more information call 333-9654.

Space News Briefs

NASA picks Small Business Innovation projects

NASA recently selected 59 research proposals for negotiation of Phase II contract awards in its Small Business Innovation Research (SBIR) program. Included are 55 small, high technology firms in 20 states. Selections were chosen from 154 proposals submitted for continuations of SBIR Phase I projects begun in 1986. Total value of awards is about \$29 million. Upcoming Phase II award selections will bring the total number of awards to more than 75 and the total value to more than \$37 million.

Smith appointed director of international relations

Peter G. Smith, a 23-year veteran of international relations work, recently was appointed director of international relations at NASA Headquarters. Smith has been chief of the International Program Policy Office of the International Relations Division since 1981. He joined NASA in 1979 as China desk officer in the International Program Policy Office. Smith received the Headquarters Creative Management Award in 1986.

JSC awards Shuttle-related contracts

JSC recently awarded contracts to IBM, McDonnell Douglas and Ford Aerospace for various support activities and equipment.

A letter contract was issued to IBM Federal Systems Division to provide General Purpose Computers and auxiliary equipment for use in the Space Shuttle Mission Simulator and support facilities. Estimated total price of the definitive contract, which runs through September 1994, is \$24.6 million. All work under the noncompetitive contract will be performed at IBM's facilities in Houston.

IBM's Federal Systems Division also won a contract to provide a National Space Transportation System Management Tracking System. The noncompetitive, cost-plus-

award-fee contract, valued at \$23.9 million, runs through September 1989 and calls for IBM to provide system integration, engineering and software development support to the NSTS Engineering Office. The work is required to implement and sustain the management information systems designed to comply with the NSTS excellence plan and to assist the NSTS management in day-to-day program decisions.

JSC also has signed a contract with McDonnell Douglas Astronautics Co. to provide Space Shuttle mission planning and analysis support. Estimated cost of the basic one-year contract is \$18,743,808. The contract includes an option to increase the effort during the year by \$8,603,000, making the one-year

total \$27,373,808. Four one-year priced option extensions, if exercised, could extend the contract through Dec. 13, 1992, and increase the total amount of the contract to \$134,086,288.

Ford Aerospace and Communications Corp. has won a contract for Shuttle Training Aircraft (STA) advanced digital avionics systems support at Ellington Field.

The cost-plus-fixed-fee contract is estimated at \$11.75 million for the basic contract period of two years. Also included are three one-year options that could extend the completion date to Dec. 31, 1992, and increase the total estimated cost to approximately \$28.5 million. The contract was awarded noncompetitively.

Film presentation remembers King

JSC employees were to commemorate the life of the Rev. Dr. Martin Luther King, Jr., at a reception in the Gilruth Recreation Center ballroom today.

The JSC Black Cultural Association was to present a film entitled "The Struggle Continues," and serve refreshments at the reception. All JSC civil service and contractor employees were invited to attend.

Federal employees will be on holiday leave Monday in observation of King's birthday.

Student experimenters meet with astronauts

(Continued from page 1)

iodide, a source of iodide ions. A crew member will open the two valves and allow the two solutions to diffuse together and hopefully grow crystals of yellow lead iodide along the membrane.

"We'll bring those back down and do studies on them to see if they are larger and purer than like crystals that we can grow here on Earth," he said. "The practical purpose is to produce X-ray film and gamma-ray film."

Lead iodide crystals are to those types of film what silver bromide crystals are to normal photographic film. The use of larger, purer crystals has helped increase the speed of normal film, Schaife said. X-ray film actually uses mercury iodide, which cannot be flown aboard the Shuttle for safety reasons. Lead iodide is the closest thing on the chemist's periodic table.



JSC Photo

THE UNKNOWN FAN—The morning after a losing football game can be tough on fans as well as players, and Deputy NSTS Program Manager Jay Honeycutt recently showed his chagrin at the New Orleans Saints loss to the Minnesota Vikings. Honeycutt wore his heart on his head instead of his sleeve.

Main engines arriving at launch site

The three main engines that will power the Space Shuttle *Discovery* on STS-26 began arriving at Kennedy Space Center this month.

Engine 2019 arrived Jan. 6, engine 2022 was shipped from the National Space Technology Laboratories on Jan. 14, and engine 2028 is expected to be moved later this month.

Acceptance testing of engines for STS-26 began in August. A

sequence of three tests was successfully accomplished at NSTL, first on engine 2019, then on engines 2022 and 2028.

One of the engines originally slated to fly on STS-26 developed a tiny leak in its oxidizer heat exchanger. After the leak was discovered, engine 2027 was pulled from the flight lineup for further testing and analysis of the heat exchanger leak. In a Dec. 29 retest,

the engine was fired for 754 seconds with the known leak. There was no increase in the extremely low level of leakage noted earlier.

Officials said the demonstration showed such a leak would not grow and possibly cause other problems if it were to occur during a flight.

There has been no indication of leakage in any of the three engines now scheduled for STS-26.

Outer boot ring refit in progress

(Continued from page 1)

associated with gimbaling. Extreme gimbaling angles tested in DM-9 are not expected to affect the DM-8 configuration boot ring, he said. More severe gimbaling angles will be tried in future tests, including Qualification Motor-6 in late March, QM-7 in late May and the Production Verification Motor in mid-June, he said.

"If this failure occurred in flight just the way it did in our DM-9 firing, it would have no adverse effect on safety at all," Thompson said. "In all of our tests, including DM-9, we are getting no heat back to that reusable flex bearing. So we've got plenty of margin in that part."

Work already has begun on

removing the DM-9-configuration boot ring from the flight nozzles being readied for shipment to KSC and replacing them with the DM-8 boot ring configuration, Thompson said.

"When we're in this situation trying to recover from an accident, we have several alternate designs for a lot of different things," said NASA Administrator James C. Fletcher, who also participated in the press conference. "It's clear from the results that the DM-8 was a better configuration than DM-9, so we're going back to the original design. That's going to happen again; we have backup designs for almost everything. The NASA Research Council Advisory Committee has

strongly urged us to do this."

Truly said no other major hardware changes are being debated in the program.

"We know what configuration we want to fly. It's just a matter of getting through successfully these next motor firings and also the processing and getting ready to fly," he said.

Fletcher also responded to speculation in Washington, D.C., that the STS-26 launch might be delayed until after the national convention or the November election.

"As long as I'm in this job, politics will continue to take a back seat to readiness," he said. "And readiness means that the Shuttle will fly only when it's as safe as we can make it."

DIAGRAM

HEADLINE

PATENTS PENDING

Documenting inventions pays, enhances center's reputation

By Kelly Humphries

For many people at JSC, inventions are something they have to come up with in order to do their jobs. The connection is clear: adapting to the space environment requires new systems, new processes, new applications, new technologies.

But many of those same JSC inventors have not yet made the connection between patents and their on-the-job ideas—a connection that can generate royalties for the inventor and esteem for JSC and NASA.

JSC Patent Counsel Ed Fein and his colleagues are spreading the word about the added emphasis patent applications are being given here, and about recent changes in the law that allow government inventors to receive significant sums for their trouble.

"I believe that when you can see how many publications our scientists and engineers have, how many patents they have, how many tech briefs they have, it's an indication of the creative effort going on at this center," Fein said.

"I think there has been some tendency in the past to think that, 'Hey, this is my job, I'm supposed to do this, and it takes all this effort to document this stuff and I've got bigger and better things to do.' But once you let people know that it is part of their job to report inventions and that element of their job is given credence by management, it happens."

Results of the added attention have been encouraging, Fein said. The number of patents filed for rose to 21 in fiscal year 1987, an increase of 75 percent over the 12 filings in fiscal year 1986. The number of patents issued rose to 11 in 1987, an increase of 83 percent over the 6 issued in fiscal year 1986.

Fein credits support from JSC's top management with much of the increase in activity. In July 1987, Director Aaron Cohen issued JSC Announcement No. 87-113 that encouraged employees to document their inventions and help enhance the overall status of JSC and its reputation as a leader in the advance-

ment of aerospace science and technology.

"We have a center director who agrees with us that creative activity is an indication of the overall 'health' of the center, and who has let his support for the patent program be known throughout the senior staff," Fein said. "Apparently, the word has trickled down."

Another reason for the filing increase, he said, may be the recently instituted annual JSC inventor luncheon that recognizes employees whose patents have been issued in the previous year. Ten JSC inventors were honored at the 1987 luncheon.

The big news in patents has been the passage of Public Law 99-502 (the Stevenson-Wydler Act) and the Oct. 13, 1987, issuance of NASA Management Instruction (NMI) 3450.2B that dictates how NASA will administer the new law.

"The most exciting thing that's come down the pike is the recent amendment to the Stevenson-Wydler Act," Fein said. "What this does for the first time is enable the government inventor to share in the royalties that are received by the government from the licensing of the invention."

"The way the statute reads, the government has to give the inventor at least 15 percent of the revenues received annually. NASA has just implemented this with an NMI that says the first \$2,000 accumulated each fiscal year will go to the inventors, plus 20 percent thereafter."

The new law is retroactive for patents issued before the law changed, he added. NASA stashed royalties in an escrow account until the NMI could be developed, and will soon begin distributing money to the inventors.

"I know for a fact that there are some retired NASA employees who are going to be surprised when they get a call that we've got a check waiting for them," Fein said with a smile.

While some people may think that patents are issued only on pioneer discoveries—light bulbs, transistors or lasers—seasoned engi-

neers know that the standard of patentability is not nearly that high, Fein said. Initial patent evaluations of inventions with humble beginnings can sometimes point out widespread applications.

Take the recently patented "Infusion Extractor," for instance. Hardie Barr, the patent attorney handling the case, said the device was created by Astronaut Franklin Chang-Diaz so that he and other space-farers could brew fresh coffee in orbit. Turns out that the same method is useful in extracting the desirable constituents from a variety of materials, the scent from flowers, for example.

"I'm a serious coffee drinker, being from Costa Rica," Chang-Diaz said. "We'd like to have fresh coffee up in space, especially for Space Station. Given that all coffee makers rely on gravity, I was trying to find a way to come up with a coffee maker that would not require gravity. When the description of the invention was submitted to the JSC patent office, they did a little bit of further study and it turns out they found a whole bunch of other uses for it. That's why they don't call it just a coffee maker."

Barr said NASA recently licensed the infusion extractor to a company in California that is going to build the machines for use in exclusive hotels. Some guests apparently don't like the smell of fresh brewed coffee that comes from other rooms, something Chang-Diaz said he finds hard to believe. The infusion extractor, by virtue of its sealed design, does not produce any odors, Barr said. The licensee wants to install them in exclusive hotels, the kind that provide hair dryers and telephones in bathrooms.

A patent application has been filed on a more technically complex invention that Chang-Diaz has been working on, a hybrid plume plasma rocket. The rocket is being designed for 300,000 mph interplanetary flight, and could cut the trip to Mars by a factor of 10.

Russell Schlorff, another patent attorney, said one of the more prolific JSC patent

holders is Herb Kobayashi, an aerospace technician in the Tracking and Communications Division's Tracking Systems Branch. Kobayashi is co-inventor in six patents, and is working on yet another with Paul Shores, Alan Cunningham and Christopher Lichtenberg.

Work began on his latest patent project, a collision avoidance system for automobiles, in 1984. Kobayashi and his colleagues are using Doppler radar to measure the distance between two moving objects. The principles behind the collision avoidance system came from an invention designed to provide accurate measurements for orbital station-keeping purposes at velocities of up to one-tenth of a foot per second.

"It's important to NASA that you file for patents," Kobayashi said. "It comes into national defense and all that. You can never tell the importance of a patent."

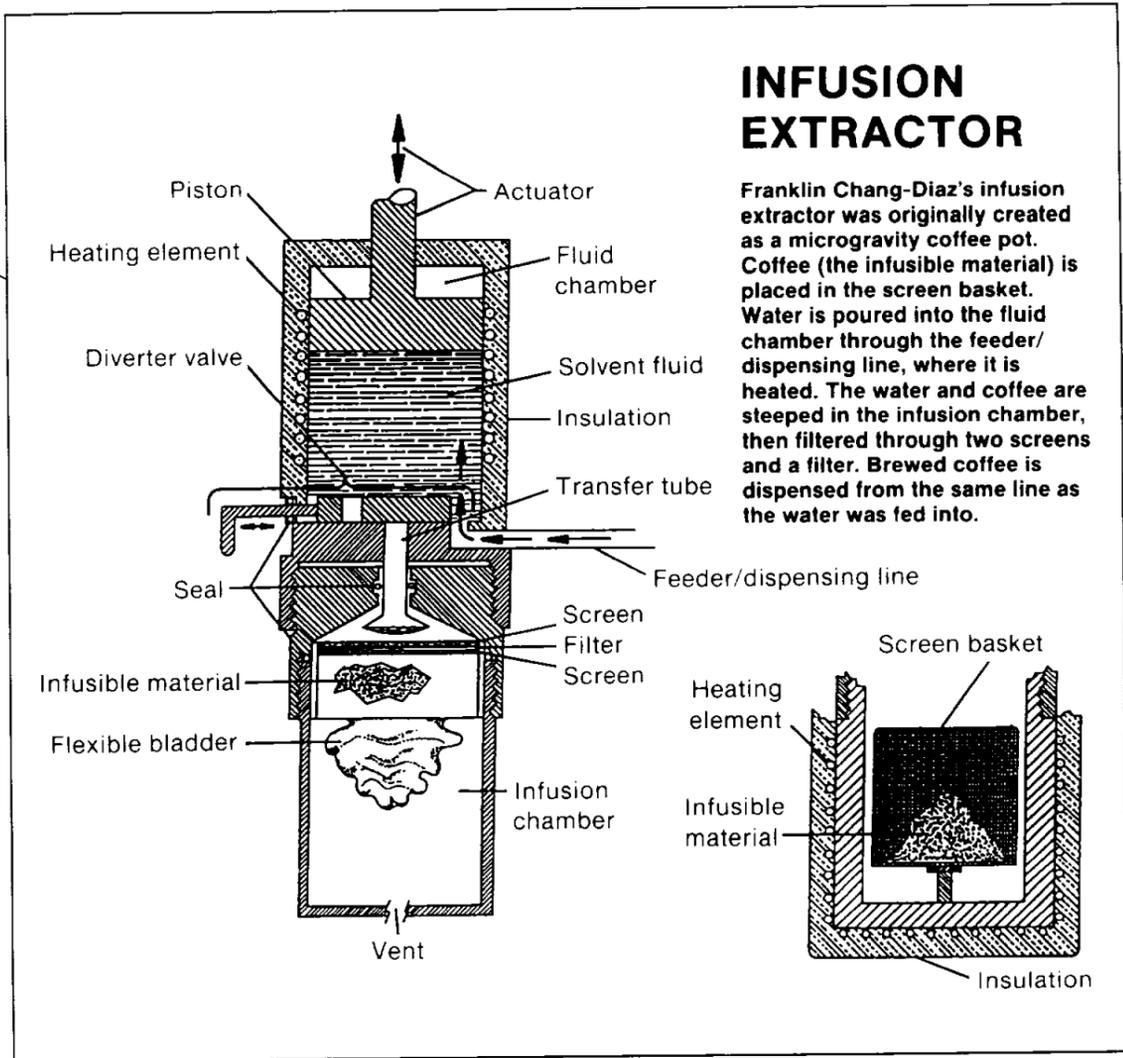
Patents also help reduce duplication of effort within NASA, he said.

"If you're working in a lab for one or two years and you're not putting down on paper what you did, the next guy may come back around and do the same thing over again," he said.

While royalties are an incentive for inventors to patent their work, NASA's reason for patenting its employee and contractor inventions is not monetary. The primary goal, Fein said, is to transfer NASA technology to the public sector. We license the patents to private companies so that they will commercialize the inventions. The exclusivity provided by a patent allows the licensee to protect its capital investment in developing the invention to the point that it is commercially available.

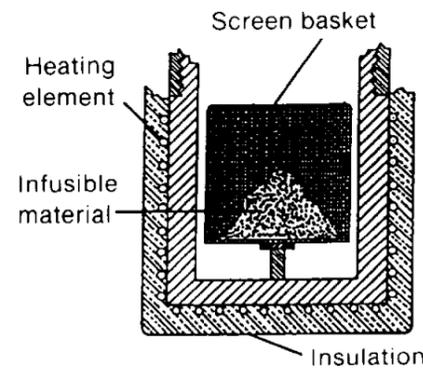
"Over the years we've discovered that if you just let everybody have equal access, there's less of an incentive for a company to pick up a piece of your technology and develop it," Fein said.

Then the American public can benefit, too.



INFUSION EXTRACTOR

Franklin Chang-Diaz's infusion extractor was originally created as a microgravity coffee pot. Coffee (the infusible material) is placed in the screen basket. Water is poured into the fluid chamber through the feeder/dispensing line, where it is heated. The water and coffee are steeped in the infusion chamber, then filtered through two screens and a filter. Brewed coffee is dispensed from the same line as the water was fed into.



Patent attorneys Russell Schlorff (left), Hardie Barr (center) and JSC Patent Counsel Ed Fein discuss patent applications in their office on the fourth floor of Bldg. 1.



STORY

PHOTOGRAPH

PHOTO CREDIT

JSC Photo

CAPTION

NASA requests Advanced X-Ray Astrophysics Facility proposals

NASA has extended a two-part request for proposals to select a prime contractor for the Advanced X-Ray Astrophysics Facility (AXAF), a long-duration, human-tended satellite designed to observe some of the most violent processes in the universe and reveal their hidden mysteries.

Earlier X-ray satellites, Uhuru and the High Energy Astronomy Observatory (HEAO) 2, gave astronomers

a sample of what lay hidden from view in the X-ray spectrum. So valuable were the HEAO 2 images that astronomers recommended establishing a long-lived orbiting X-ray observatory.

Many astronomers believe the massive emissions from the cores of many galaxies is evidence for the existence of "black holes," vast gravity pits from which even light cannot escape. Matter falling into these grav-

ity pits would release X-ray emissions. By imaging these emissions with AXAF, details of the immediate vicinity of the black hole will be revealed.

Scientists and astronomers also hope to use AXAF to study quasars, the most powerful energy sources in the universe, and spinning neutron stars.

AXAF's value reaches beyond astronomy. It will be an important new tool for basic research in plasma

physics, the fundamental properties of matter, and the laws of physics. AXAF may even provide data from which astronomers can deduce the exact age of the universe.

Industry candidates for this award include Lockheed Missiles and Space Co., Sunnyvale, Calif., and TRW Inc., Redondo Beach, Calif. Proposals are due in 60 days. Both firms have successfully completed 32-month AXAF design definition studies for

Marshall Space Flight Center, which manages the AXAF program. The contractor, to be selected in June, will be awarded a part-one extended definition contract to run through December.

As envisioned, AXAF will be 14 feet in diameter, 45 feet long and weigh 12-15 tons. It is to be placed into a circular orbit 320 miles above the Earth, and operate for about 15 years.

Roundup Swap Shop

All Swap Shop ads must be submitted on a JSC Form 1452. The forms may be obtained from the Forms Office. Deadline for submitting ads is 5 p.m. the first Wednesday after the date of publication. Send ads to Roundup, AP3, or deliver them to the Newsroom, Bldg. 2 Annex, Room 147. No phone in ads will be taken.

Property & Rentals

Sale. 3-2-2, new paint, carpet, garage doors, reconditioned, buy from owner, \$48,000. Quinn, x35596 or 481-0287.

Lease. 2 BR condo, next to NASA, W/D conn., ice maker, fans, miniblinds, cable TV, storage room, no pets. 488-0719.

Lease. 2 BR condo, available 2/22 to 2/29, ski Lake Tahoe. Stateline, NV, close to Stagecoach, ski lift at Heavenly Valley, \$300. Tom, x38298 or 488-4089.

Lease. CLC Camino South, 4-2-2, fenced, hi eff. A/C, no pets, deposit. Ryborn, 488-1301.

Lease. CLC Piper's Meadow, 3-2-2, FPL, fence, new paint, patio, dining room, gas utility, \$525/mo. 482-6609.

Lease. Friendswood, Forest Bend, 3-2-2, fence, patio, new paint, \$475/mo. 482-6609.

Lease. League City, fourplex, 2 BR, W/D appliances, alarm, storage, covered parking, \$400/mo., deposit. Gordon, x33269 or 481-3787.

Sale. CLC, 3-2-2, broker-owner, new vinyl flooring, stain master carpet, FPL, fans, remodeled kitchen, microwave, custom cabinets, screened patio, gas grill, near park, Whitcomb Elementary School, \$68,000. Bonnie, x30020 or 488-5390.

Sale. Nacogdoches 3-1, paneled interior, corner lot, 1 acre, \$32,000. x39393 or 946-4752.

Lease. Middlebrook 3-2-2, fenced, \$500/mo. 480-6516.

Sale. 3-2-2, new paint, carpet, garage doors, 4 mi. from NASA, buy from owner. L.T., x35596.

Sale. 13.5 acres, gently rolling wooded east TX land, fronts county blacktop, near Tyler and Henderson, assumable low cost TX Vet. loan. McLeish, 480-7445.

'77 Mobile home, set up at Texas A&M, 14' x 65', 2-2, central A/H, new carpet, miniblinds, \$8,000. Doug, x33399 or 480-2929.

Lease. Baywind II 2-2 5, large 2-story, new kitchen floor, fresh paint, FPL, W/D, fans, pool, tennis, \$470/mo. x30715 or 280-8608.

Cars & Trucks

'81 Camaro V6, ex. cond., new shocks, brakes, tires, \$3,490 OBO. Patel, x32103 or 242-0960.

'77 Pontiac Grand Prix, loaded, 91K mi., \$1,000. 482-7156.

'86 Toyota SR5 XTRACAB truck, auto., overdrive, 13K mi., ex. cond., \$7,800. x30186.

'86 Mazda RX7, 17K mi., 5 spd., rotary, AM/FM/cassette, AC, power sunroof, rear window louvers, ex. cond., \$13,000 OBO. 480-0907.

'80 Mazda 626, 2 dr., 68K mi., AC, AM/FM, ex. cond., \$2,200 OBO. Steve, 280-1733 or 480-6859.

'85 Grand Prix/Brougham, loaded, good cond., 32K mi., \$7,600 OBO. Sambolin, x35460 or 991-2431.

'73 Thunderbird, V8, loaded, leather, 81K mi., white, black vinyl top, \$2,000 OBO. Kevin, x33838 or 471-7889.

'67 Mustang, square back, 289V8, C-4 auto, transmission, PB, PS, new exhaust system, radiator, water pump, battery, carpet, \$2,700. 532-3362.

'85 Honda Prelude, mint cond., \$11,000 or \$2,000 and take over payments \$224/mo. Leon, x38514 or 337-5381.

'80 Olds Cutlass Supreme, white, V8, 2 dr., \$2,995 OBO. Rick, x36156 or 480-1218.

'81 Olds 88, loaded, good cond., 4 dr., \$2,680. Dick, x31438 or 482-3989.

'80 Olds Toronado, power moonroof, Kenwood cassette, loaded, 67K mi., \$2,995. Jerry, x38922 or 333-9003.

'83 Porsche 944, champagne, PW, leather & cloth interior, sunroof, 64K mi., standard, \$11,000. 282-4051.

'87 Nissan 300ZX, loaded, 3K mi., 5 spd., \$18,000. Carolyn, 333-6500 or 333-5516.

'78 VW Bug convertible, white, ex. \$4,500. Mike, x32803 or 482-0325.

'85 Ford Van, Anaheim conversion, loaded, ex. cond., \$11,000. Mike, x32803 or 482-0325.

'81 Toyota Cressida, AC, auto., good cond., \$4,700. Ron, x32751.

'66 Ford Mustang, V8, 289 engine, auto., new tires, many new parts, AM/FM/tape, needs interior work, \$2,800. 332-8188 or 488-9323.

Cycles

'78 Honda CB550K, runs but needs work, \$400. Brad, x31678 or 338-1252. Honda moped, 400 mi., good cond., \$75. Kent, 333-6179 or 484-2411.

'87 (2) moped, EME1500, new, \$425 ea. x32103 or 242-0960.

'85 Suzuki GS 700E, 2,500 mi., red/white, ex. cond., Bell Aerostar helmet, \$1,995. John, x36484 or 486-1186.

New Panasonic men's bike, green & white, 21" from center to top, double butted, CR-MO Tange 900 (frame), Shimano platform pedals, light action shifting, seal system hub, quick release front, rear wheels, extra set of tubes, was \$350, now \$250. Julia, 333-0901.

Boats & Planes

'68 'H' model Cessna C-150, 2500 ITT, 330 SMOH 360 CH Cessna radio XPDR, new interior, \$10,000. (409) 744-2830 or 480-7226.

'13' Oday sailboat, trailer, life jackets, extra sail, \$275. 282-3267 or 484-1820.

'85 Prindle Catamaran 18', white, stainless, steel trailer, rainbow sails, ex. cond., \$3,100 OBO. David, x31397 or 338-2763.

'84 Master craft, black & gray, deluxe package, \$13,500. 326-3505.

Household

Twin/bunk beds, desk, chest w/hutch, delivery and pickup, rent \$10 mo., \$100 deposit. Hill, x32185 or 944-5611.

2 piece sectional sofa, dark beige, \$200. Teresa, 487-1883.

Dinette set, 4 chairs, need work, table, ex. cond., \$75. Nancy, 482-5607.

Blue ceramic dining table, \$250, TV/VCR stand, \$35; brass/glass FPL screen, 46" x 26", \$60. Tricia, 486-1829.

Whirlpool W/D, \$300 OBO. Pitre, 282-4271 or 996-9646.

Antique grandfather clock w/chimes, 7 1/2 ft., \$2,500; 2 matching carved unusual throne chairs, \$500; antique school desk, \$25; oak antique library table w/fitted glass top, \$375. 488-5564.

Water bed, super single, comforter, sheets, \$150. Reba, x32558.

5-piece dinette set, rust-tweed herculon fabric, wrought iron base, good cond., \$25. Beth, 480-2817.

2 matching bar stools, swivel, metal framed vinyl, brown covered, good cond., \$25 ea. or both for \$45. Bob, x32193 or 332-3817.

Color TV, '68, 23", semi-working, good sound, fuzzy picture, free. Killingsworth, x38396.

11 pc. copper bottom pots & pans, new, was \$130, now \$75. Mandy, 480-8190 or 480-2265.

General Electric gas dryer, heavy duty, ex. cond., \$150. Beth Ann, 333-6191.

Desk/vanity dresser for child, white French Provincial, good cond., \$50. 488-6521.

General Electric stove, almond, ex. cond., \$150. Deena, x32427 or 338-2429.

Audiovisuals

Audio equip., Ramko mixer, broadcast quality, value \$8,000, \$3,000; QRK turntable w/G.E. tonearm, \$125; Electravoice microphone, stand, \$125; amps, pre amps, cables, Scotch, 5" & 7" reels, BO, 480-7226.

Sony amplifier/tuner, \$75; (2) Kierksaeter stereo speakers, \$75; 400K Macintosh disk drive, \$50. Jack, x32624 or 488-7159.

Commodore 64 software, books, productivity and games. Steve, x35272.

Star Gemini 10X dot matrix computer printer, ex. cond., \$115. Dan Mangieri, x30811 or 488-5471.

HP Digital Cassette drive for HP-41C, HP-IL interface module, ex. cond.,

was \$675, now \$400. Carlos, x38879 or 554-7727.

IBM PC XT, 512K RAM, 10MB hard disk, mono monitor w/graphics, software, \$750. Robert, x39260.

Commodore 64, 1541 disk drive, Amber monitor, printer, software, \$250; Midland 5" B&W TV, AM/FM, AC/DC, car cord, \$50; Atari video game, 7, \$40. Carl, 332-1487.

Commodore 64, CPU, disk drive, turbo fast loader, \$325, ex. cond. Algie, 488-1444.

Leading Edge "XT", 20 MEG HD, 640K, EGA graphic, hi-res. color monitor, Lotus 1-2-3, gwbasic, word perfect, pro-design, microsoft mouse, surge protector, \$2,295. x36484 or 486-1186.

Wanted

Looking for car pool from Westheimer/Wilcrest area to JSC Bldg. 13. Lili, x38949.

Want to buy electric trains. Don, x37832 or 996-1425.

Want small chest of drawers, pecan or rattan. Beth, 480-2817.

Want babysitter, single child caregiver for 2 mo. old boy, needed weekdays, 7 a.m. to 4.30 p.m., Feb. 1 to June 3. Rick, x38519 or 996-7630.

Want roommate to share 3-2-2 house in CLC, non-smoker, \$300, 1/2 utilities, 4 min. from JSC. Sutton, 488-8029.

Want vegetarians interested in forming club to share recipes, info. on nutrition. Don Brown, x38241 or 488-0754.

Musical Instruments

5 piece Rogers drum set, high hat, ride, crash symbols, extra heads, sticks, \$550. Reza, 282-3267 or 484-1820.

Baldwin organ, ex. cond., easy to learn, ideal for child, \$500. Bonnie, 930-9348.

Spencer flute, closed hole, C concert, ex. cond., \$195. 488-6521.

Photographic

Nikon AF, fl. 4/50 mm, 80/200 mm Nikkor lens w/filter, SB-16 flash, ex. cond., \$1,100. x36484 or 486-1186.

Pets & Livestock

Lab puppies, 5 black, 2 yellow, \$50. James, 554-6240 or 282-4260.

Registered appaloosa gelding, 6 yrs. old, all tack, grooming supplies, ropes, \$1,200 OBO. Shayla, x30122.

Flame point Himalayan Persian male cat, 2 yrs. old, neutered, all shots, CFA registered, \$50. Lee, 486-8563.

Akita dog, AKC registered, 2 year old male, affectionate, protective, \$250. 474-7433.

Lost & Found

Raleigh 6-spd. bike missing, feared stolen from Mission Control Center. Jon Axford, x37671 or 332-1473.

Personals

Anyone interested in a camping trip to Enchanted Rock state park, (west of Austin), to rappel, spelunk, and hike, beginners welcome. Leah, x34544 or 480-8780.

Miscellaneous

Hirsh saw table, accessories for mounting a hand circular saw, jig saw or routes, was \$50, now, \$25. Howard, 282-2914.

Used golf clubs, iron, wood, putters, wedges, collectors. Jerry, x38838 or 333-5181.

Typewriter table, foldup sides, \$25, microwave or TV hand-built table, \$25; small mahogany office bookcase, table top, \$30; 2 matching straight chairs, \$20; TV stand w/rollers, \$10. 488-5564.

Teen's clothes, Polos, jeans, OPs, Levis, size 14-18, ex. cond.; glassware, some antique, some deco, collectibles. x33277 or 480-7194.

15 gallon electric water heater, 120-

240V, \$10. Fred, 333-2166 or 282-4262.

Sears whirlpool bath model #2286, attachment kit, \$50. Carl, 332-1487.

Moving sale, Jan. 8-10 & 15-17, 9522 Gulf Bridge, south of Alameda Mall, baby clothes, misc. lawn equip., living & dining furniture, 55 gal. aquarium, desk, camping weights. Sambolin, 991-2431.

Ruger 44 Magnum carbine w/Redfield 4X wide angle scope, together or separate. Smith & Wesson 1000 12 Ga., auto 30" barrel w/full choke. x36161.

Chrysler 440 engine, '71 model, overhauled in '82. \$350. Dick, x31438 or 482-3989.

AT&T mouse for 6300, plugs into AT&T keyboard, was \$150, now, \$75.

Jeff, x35534 or 480-6859.

New Graco "Swyngomatic" baby swing, carrier, feeding chair, \$40. Carlos, 554-7727.

Credenza, black metal, wood grained top, sturdy, ex. cond., 60" X 20"; Waterford crystal Christmas ornament, '78, first year issued, \$20. x34044.

Iron, \$5; ironing board, \$6; toaster, \$6; lamps, \$15 ea.; bar stool, \$5; wheel barrow, \$7; Panasonic portable stereo AM, SW1, SW2-3 way power, \$25; ice cream maker, \$5; oscillating fan, \$6; fan, \$7; baby Swingomatic, new, \$7; baby walker, \$2; beach chair, \$5; cement blocks, \$1 ea.; light fixtures, \$1 ea. 333-6449 or 480-2870.

Gilruth Center News

Call x30304 for more information

EAA badges—Dependents and spouses may apply for pictured I.D. badges on Jan. 20 and Feb. 1, between 6:30 and 8:30 p.m.

Defensive driving—Course is offered Feb. 20 from 8 a.m. to 5 p.m. and costs \$20.

Weight safety—This is a required course for those employees wishing to use the Rec Center weight room. The class will be Jan. 28.

Country and western dance—Beginning class starts Jan. 25 and continues every Monday from 7 to 8:30 p.m. for six weeks. Cost is \$20 per couple.

Physical Fitness—The next 12-week course of the JSC Physical Fitness Program will be held April 4 to June 24 from 11 a.m. to noon or from 4 to 5 p.m. All NASA and contractor employees and dependents are eligible upon completion of an acceptable physical exam and a maximal treadmill stress test. For more information call x30301.

Cookin' in the Cafeteria

Week of January 18 — 22, 1988

Monday — French Onion Soup; BBQ Sliced Beef, Parmesan Steak, Spare Rib w/Kraut, Chili & Macaroni (Special); Ranch Style Beans, English Peas, Mustard Greens. Standard Daily Items: Roast Beef, Baked Ham, Fried Chicken, Fried Fish, Chopped Sirloin, Selection of Salads, Sandwiches and Pies.

Tuesday — Split Pea Soup; Meatballs & Spaghetti, Liver & Onions, Baked Ham w/Sauce, Corned Beef Hash (Special); Buttered Cabbage, Cream Style Corn, Whipped Potatoes.

Wednesday — Seafood Gumbo; Cheese Enchiladas, Roast Pork w/Dressing, BBQ Link (Special); Pinto Beans, Spanish Rice, Turnip Greens.

Thursday — Beef & Barley Soup, Roast Beef w/Dressing, Fried Perch, Chopped Sirloin, Chicken Fried Steak (Special); Whipped Potatoes, Peas & Carrots, Buttered Squash.

Friday — Seafood Gumbo; Fried Shrimp, Baked Fish, Beef Stroganoff, Fried Chicken (Special); Okra & Tomatoes, Buttered Broccoli, Carrots in Cream Sauce.

Week of January 25 — 29, 1988

Monday — Cream of Potato Soup; Franks & Sauerkraut, Pork Chop, Potato Baked Chicken, Meat Sauce & Spaghetti (Special); French Beans, Buttered Squash, Buttered Beans. Standard Daily Items: Roast Beef, Baked Ham, Fried Chicken, Fried Fish, Chopped Sirloin, Selection of Salads, Sandwiches and Pies.

Tuesday — Navy Bean Soup; Beef Stew, Liver & Onions, Shrimp Creole, Smothered Steak w/Dressing (Special); Corn, Rice, Cabbage, Peas.

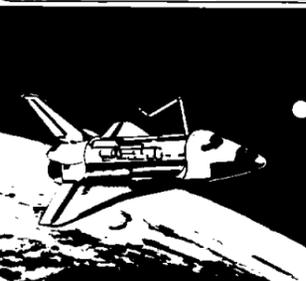
Wednesday — Seafood Gumbo; Roast Beef, Baked Perch, Chicken Pan Pie, Salmon Croquette (Special); Mustard Greens, Italian Green Beans, Sliced Beets.

Thursday — Beef & Barley Soup; Beef Tacos, Diced Ham w/Lima Beans, Stuffed Cabbage (Special); Ranch Style Beans, Brussels Sprouts, Cream Style Corn.

Friday — Seafood Gumbo; Fried Shrimp, Deviled Crabs, Ham Steak, Salisbury Steak (Special); Buttered Carrots, Green Beans, June Peas.

NASA
Lyndon B. Johnson Space Center

Space News Roundup



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